

24th, Saint Vincent, Minn.; Ardenia, N. Y. 25th, Gardiner, Me. 27th, Pekin, Ill. 28th, Palermo, N. Y.

THUNDER-STORMS.

Thunder-storms occurred as follows: Mobile, Ala., 1st; Alcatraz Island, Angel Island, Oakland, Presidio of San Francisco, and San Francisco, Cal., 4th; Red Bluff, Cal., 23d; Titusville, Fla., 1st; Limona, Fla., 18th; Savannah and Quitman, Ga., 1st; Globe and Salina, Kans., 5th; Manhattan, Kans., 6th; Liberty Hill, La., 15th; Conception, Mo., 4th; Pierce City, Mo., 6th; Charleston and Stateburg, S. C., 1st; San Antonio, Tex., 12th; Cedar Hills, 14th; Palestine, Tex., 18th.

ELECTRICAL PHENOMENON.

Fort Assinaboine, Mont.: there was a constant display of light on the wires during the storm of the 11th, and the wires in the telegraph office became almost unmanageable.

Huron, Dak.: during the storm of the 12th metals and other substances emitted electrical sparks. Severe shocks were felt by persons shaking hands.

Fort Maginnis, Mont.: during the storm of the 12th the atmosphere was very highly charged with electricity from 3 p. m. until midnight, interfering considerably with the working of the telegraph lines; upon touching any metallic surface shocks were felt.

MISCELLANEOUS PHENOMENA.

METEORS.

Orono, Me.: a meteor, apparently about one-fourth the size of the moon, was observed at 6.40 p. m. on the 4th; it started near the zenith and moved in direction south 40° east, disappearing when within about 40° of the horizon. Although the sky in the region of its path was cloudy at the time it illuminated the horizon with a bright light.

Fort Sill, Ind. T.: an unusually bright meteor was observed at 8.45 p. m. on the 4th; it started from about 75° above the southwest horizon, moved a little to the southwest, and disappeared when at an altitude of about 30°; during the passage of the meteor the southwestern sky was illuminated as though the full moon shone; it was visible for ten seconds. This meteor was also seen at Fort Reno, Ind. T., and was probably the same seen at Abilene, Tex., and Yates Centre, Kans.

Meteors were also observed as follows:

1st, Wythville, Va. 2d, Webster, Dak., and Yates Centre, Kans. 4th and 6th, Rappahannock, Va. 7th, Wytheville and Dale Enterprise, Va. 9th, Tribune, Kans. 10th, Lamar, Mo.; Woodstock, Md.; Dale Enterprise, Va.; Rappahannock, Va. 11th, Woodstock, Md.; Dale Enterprise, Va. 12th, Nashua, N. H.; Wytheville, Va.; Fort Stanton, N. Mex. 13th, Lead Hill, Ark., and Manhattan, Kans. 14th, Provincetown, Mass. 20th, Fall River, Mass. 23d, Dubuque, Iowa. 24th, Wytheville, Va. 27th, Washington City and Chicamcomico, N. C. 28th, Omaha, Nebr., and Woodstock, Md. 30th, Grand Junction, Colo. 31st, Variety Mills, Va.

MIGRATION OF BIRDS.

Geese flying southward.—Yates Centre, Kans., 1st, 3d; Chattanooga, Tenn., 3d; Kitty Hawk, N. C., 10th; Wilmington, N. C., 11th, 20th; Red Bluff, Cal., 23d.

Geese flying northward.—Red Bluff, Cal., 10th; Corsicana, Tex., 14th; Augusta, Ga., 21st, 27th; Globe, Kans., 29th.

Brants flying southward.—Kitty Hawk, N. C., 10th.

MIRAGE.

Corpus Christi, Tex.: at 3 p. m. on the 2d Mustang Island, twenty-two miles from this place, was plainly seen on the horizon, over Corpus Christi Bay; the phenomenon continued until 5 p. m. A similar display was observed from 11 a. m. to 4 p. m. on the 27th.

Fort Maginnis, Mont.: Mason Lake and its surroundings, situated about forty miles distant, were plainly seen from 9.45 to 10.45 a. m. on the 23d.

Webster, Day Co., Dak.: unusually fine displays of mirage were observed on the 29th and 31st; on the first-named date, Wobbay, and on the latter, Bristol, and their surroundings, were plainly seen.

Mirages were also observed as follows: Garden City, Dak., 29th; Cedar Keys, Fla., 21st; Tribune, Kans., 1st, 2d, 3d, 10th, 11th, 17th to 19th, 23d, 25th, 26th, 29th, 31st; Fort Maginnis, Mont., 23d; Poplar River, Mont., 14th, 17th, 20th, 21st, 28th, 29th; Marquette, Nebr., 2d, 10th, 18th, 26th, 29th to 31st; Corpus Christi, Tex., 28th.

PRAIRIE FIRES.

Fort Sill, Ind. T., 2d; Fort Reno, Ind. T., 4th.

SAND STORMS.

Willcox, Ariz., 3d, 4th, 10th; Fort Grant, Ariz., 4th, 10th, 18th.

SUN SPOTS.

Mr. H. D. Govey, North Lewisburg, Champaign Co., Ohio, observed sun spots as follows: 1st, 2d, 10th, 13th, 14th, 18th, 21st.

VERIFICATIONS.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during January, 1888, it was practicable to determine the justification or failure of fifty-four; justified, thirty-seven, or 68.52 per cent. Of the above, twelve were ordered for cautionary signals; number justified, seven, or 58.33 per cent. Forty-two storm signals were ordered; justified, thirty, or 71.43 per cent. Total number of direction signals ordered, fifty-six; justified, fifty-four, or 96.43 per cent. Number of signals ordered for easterly winds, eleven; justified, ten, or 90.99 per cent. Number of signals ordered for westerly winds, forty-five; justified, forty-four, or 97.78 per cent. Number of storms without signals, none. Number of signals ordered late, *i. e.*, after the justifying velocity had begun, twelve, or 22.22 per cent.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered from Office Chief Signal Officer, two hundred and sixty-one; justified, one hun-

dred and eighty, or 68.97 per cent. Eighty-one cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, seventy-five, or 92.59 per cent., were justified.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for January, 1888, as determined from comparison of succeeding telegraphic reports are given in the table below.

The predictions for all districts east of the Rocky Mountains for January, 1888, were made by Junior Professor H. A. Hazen, except those for Minnesota, eastern and central Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer; those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor O. F. Marvin:

Percentages of indications verified, January, 1888.

States.		States.	
Maine.....	73.84	Kentucky.....	69.94
New Hampshire.....	74.19	Ohio.....	69.39
Vermont.....	70.10	West Virginia.....	68.10
Massachusetts.....	69.97	Indiana.....	70.61
Rhode Island.....	69.84	Illinois.....	71.97
Connecticut.....	67.32	Lower Michigan.....	71.19
Eastern New York.....	69.52	Upper Michigan.....	72.42
Western New York.....	65.03	Wisconsin.....	69.90
Eastern Pennsylvania.....	74.29	Minnesota.....	72.87
Western Pennsylvania.....	65.52	Iowa.....	75.45
New Jersey.....	73.55	Kansas.....	79.35
Delaware.....	73.32	Nebraska.....	78.26
Maryland.....	75.12	Missouri.....	73.84
District of Columbia.....	74.00	Colorado.....	75.00
Virginia.....	72.55	Eastern and central Dakota.....	72.61
North Carolina.....	73.39	Southern California.....	81.22
South Carolina.....	74.58	Northern California.....	77.32
Georgia.....	71.03	Oregon.....	75.87
Eastern Florida.....	77.00	Washington Territory.....	79.10
Western Florida.....	71.03	By elements:	
Alabama.....	71.68	Weather.....	74.15
Mississippi.....	74.58	Wind.....	75.36
Louisiana.....	74.48	Temperature.....	69.03
Texas.....	73.23		
Arkansas.....	73.55	General average.....	72.22
Tennessee.....	68.65		

* In determining the general average percentage and the percentages for the different elements, Minnesota, eastern and central Dakota, and Pacific coast states have not been included.

LOCAL VERIFICATIONS.

The following is from the report of the "Michigan State Weather Service" for January, 1888:

Weather and temperature signals are now displayed in one hundred and forty-three towns in the state, and on the baggage-cars of twenty-six trains on eight principal railroads of the state.

The indications and cold-warnings are issued by the Chief Signal Officer and distributed to the different stations through the central office. The indications

are issued at 1 a. m. daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentage of verification of these indications for January is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 78.8 per cent.; weather, 83.5 per cent.; temperature and weather, 80.9 per cent.

The percentage of verification of weather predictions for January on the D., G. H., and M. R'y., is 80.0 for weather, and 74.3 for temperature; on the C. & G. T. R'y., weather, 80.7, and temperature, 76.0; P. H. & N. W. R'y., weather, 85.0, and temperature, 79.7; M. C. R'y., for weather, 86.2, and for temperature, 83.7; G. R. & I. R'y., weather, 81.3, and temperature, 81.3; C. & W. M. R'y., weather, 90.0, and temperature, 77.7; P. O. & P. A. R'y., weather, 80.0, and temperature, 79.0.

Cold-wave signals were ordered by the Chief Signal Officer on the 1st, and were verified on the 2d; on the 6th and continued until 7 a. m. of the 8th, and were justified by average fall of 26° in temperature; on the 18th and continued until 8 p. m. of the 14th; on the 15th at 7 a. m. and continued until 7 a. m. of the 16th; on the 19th at 6.30 p. m. and continued until 7 a. m. of the 21st; on the 25th at 6.15 p. m. and continued until 7 a. m. of the 28th. The temperature fell from 15° to 25° in the time specified by the warnings.

Many favorable comments were made on the benefits derived.

The following is from the January, 1888, report of the "South Carolina Weather Service":

The percentage of verification of the weather and temperature predictions for the whole state was: for weather, 71.5; for temperature, 74.7.

The following is from the "Tennessee State Board of Health Bulletin" for January, 1888:

There were six cold-wave predictions—that of the 4th being partly verified, failing in the western division, also that of the 18th being only partly verified, failing in some portions of the middle division, and those of the 6th and 18th being twenty-four to forty-eight hours later than the predictions indicated. The others were generally fully verified.

The percentage of verification of weather and temperature predictions, furnished daily from the Signal Office at Washington to the various stations in the state during the month was, for the state: weather, 64.8 per cent., and temperature, 67.2 per cent.

STATE WEATHER SERVICES.

The following extracts are republished from reports for January, 1888, of the directors of the various state weather services:

The "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

The temperature was about normal.

Although there were rainy days during the month, still the precipitation was only 0.78 of an inch above the normal. The season was quite unpleasant on account of the constant dampness of the atmosphere.

In this section of the United States January is generally a disagreeable month, both on account of the degree of cold and also the frequency of rains, so that the past month has only been exceptionable because of the small number of really cold days it contained.

There were three cold waves predicted, viz., on the 7th, 14th, and 15th; that of the 15th was the only one verified.

Summary.

Atmospheric pressure (in inches).—Monthly mean, 30.30; maximum observed, 30.69, at Auburn, on the 19th; minimum observed, 29.79, at Montgomery, on the 1st; range for state, 0.90.

Temperature (in degrees Fahr.).—Monthly mean, 46.4; highest monthly mean, 51.1, at Montgomery; lowest monthly mean, 39° 3', at New Market; maximum, 78°, at Newton, on 6th; minimum, 10, at Gadsden, on the 19th; range for state, 68; greatest local monthly range, 62, at Gadsden; least local monthly range, 48, at Selma.

Precipitation, including melted snow (in inches).—Average for the state, 4.74; greatest, 11.50, at Selma; least, 0.54, at Bermuda.

Wind.—Prevailing direction, northwest.

The "Monthly Review of the Illinois Weather Service," Col. Charles F. Mills, Springfield, director:

The meteorological features of January presented some rather unusual characteristics, the principal of which were high barometer, low temperature, and some remarkably sudden changes.

The mean temperature of the month was 5° 8' below the normal of the past ten years; the difference being greatest in the northern and least in the southern division, 6° 4' in the former and 4° 4' in the latter. The 15th and 16th were the two coldest days. The most remarkable feature, however, was the great range of the 13th, when the thermometer fell from 50° to 55° in the northern and western parts of the state, and from 35° to 45° in the southern. This was the greatest, as well as the most sudden, fall ever recorded in the state. On twenty-three days during the month the temperature was reported below zero, and the lowest point reached was 30° below. The precipitation was 0.24 inch above the average of the past ten years, dis-

tributed as follows: 0.32 inch below in the northern division, 1.50 inches above in the central, and 0.38 inch below in the southern. Except in the northern portion of the state the greater portion of precipitation was in the form of rain and sleet; the snowfall was below the average. The greatest precipitation occurred on the 6th, 12th, and 14th.

The "Indiana Weather Service," Prof. H. A. Huston, of Purdue University, Lafayette, director:

The mean barometric pressure over Indiana during January, 1888, was 0.145 inch above normal; the highest pressure occurred on the 16th, when the barometer at many places rose to the unusual height of over 31 inches; the lowest, 29.71, occurred on the 1st. Barometric changes were very abrupt and frequent, especially so on the 1st, 4th, 6th, 13th, and 30th. On the 13th the barometer, in fifteen hours, fell from about 30.5 to 29.9 inches, and rose equally as fast to 30.5 again, and continued to rise steadily until it reached its greatest height on the 16th.

The month was uniformly cold. The mean temperature was slightly below the normal, and the daily mean temperature was only above the normal from the 4th to 7th and 29th to 31st; nevertheless the reading of the thermometers was not as low as during January, 1887, especially so in the central and southern parts of the state.

The precipitation during January was generally slightly above normal, the most frequent falls occurred during the first half of the month. On the 16th sleet fell at many places from 3 to 6 inches deep; being preceded by rain and followed by snow and a temperature below zero, a solid cover of ice formed which lasted for many days. The snowfall in the central and southern parts, was slight, but in the northern part it reached a depth of fifteen inches.

Summary.

Atmospheric pressure (in inches).—Monthly mean, 30.289; maximum observed, 31.071, at Lafayette, on the 16th; minimum, 29.710, at Worthington and Indianapolis, on the 1st; range for state, 1.361; greatest local range, 1.230, at Indianapolis; least local range, 0.999, at Mount Vernon.

Temperature (in degrees Fahr.).—Monthly mean, 28.2; highest monthly mean, 32.3, at Marengo; lowest monthly mean, 16.0, at La Grange; maximum, 67.0, at Degonia Springs, on the 6th; minimum, —16.0, at Logansport, on the 16th; range for state, 61.5; greatest local monthly range, 78.0, at Logansport; least local monthly range, 52.0, at Angola.

Precipitation, including melted snow (in inches).—Average for the state, 3.08; greatest, 5.83, at Huntington; least, 1.18, at Bloomington.

Wind.—Prevailing direction, northwest.